

Introducing CineGrid

MAGIC

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www.cinegrid.org

What is CineGrid?

- ❑ International non-profit membership organization
Founded 2004
- ❑ Mission – to build an interdisciplinary community
Focus – the research, development & demonstration of networked collaborative tools
To enable – the production, use, preservation & exchange of very high-quality digital media over high-speed photonic networks
- ❑ Members – media arts schools, research universities, scientific labs, post-production facilities & hardware and software developers around the world
- ❑ Connected via 1 G Ethernet & 10 G Ethernet networks
For – research & education



Convergence Motivates CineGrid

- Media technology historically driven by 3 sectors
 - Entertainment, media, art and culture
 - Science, medicine, education and research
 - Military, intelligence, security and police
- Adoption of digital media means all 3 face converging needs
 - Fast networking for distributed applications
 - Access to shared devices
 - Specialized computers and massive storage
 - Collaboration tools for distributed teams
 - Robust security for intellectual property
 - Higher quality sound and picture
 - A next generation of trained professionals



Trends in Cinema

- Movie-making is going digital and going global. Local talent is key!
- Post-production is almost all digital already. Increasingly distributed!
- Many movies still shot using 35mm film cameras, then scanned as the first step in the “digital intermediate” process, but digital cameras are getting better and better!
- Digital cinema projection technology is enabling better picture quality: From 2K digital to 4K digital, plus a new generation of 3D stereo movies... Avatar !



Trends in Cinema

- Cinema sound quality is improving. From stereo, to compressed 5.1, to uncompressed 5.1, to uncompressed 7.1 surround sound!
- Of the roughly 100,000 screens worldwide, only 15% are digital today. But recent financing announcements in the USA lead to forecasts that 60-70% of American screens will be digital by 2013!
- Fast networks are becoming critical infrastructure for media companies involved in production, post-production and distribution!
- Education of the next generation of media professional is critical!



1981

Francis Ford Coppola with Dr. Takashi Fujio

“First Look” at Electronic Cinema



2001

NTT Network Innovations Laboratory

“First Look” at 4K Digital Cinema



2004 OptIPuter Vision for the Next Decade

Gigapixels @ Terabits/sec

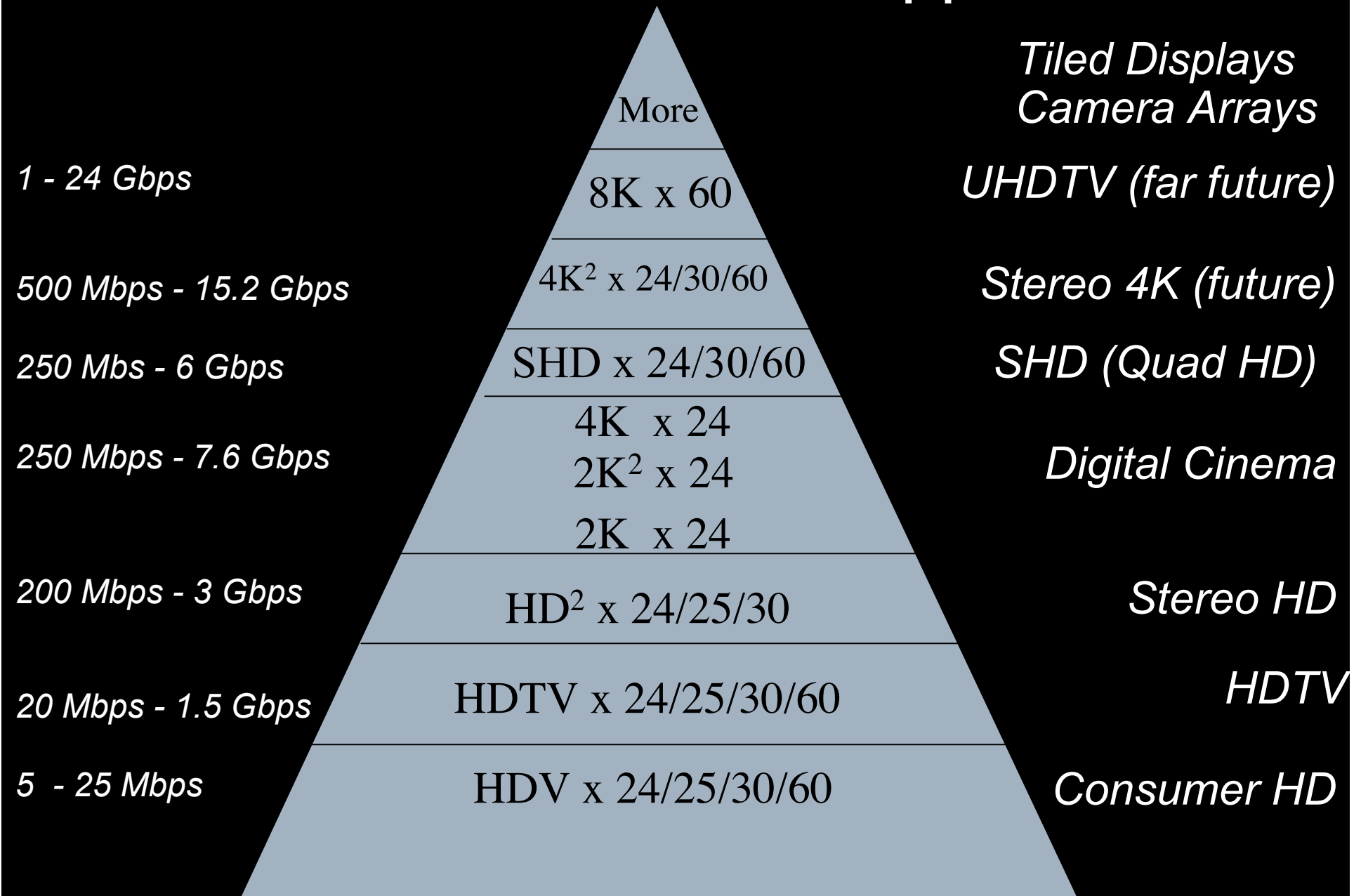
4K
Streaming Video

Gigapixel
Wall Paper

Augmented Reality
No Glasses

1 GigaPixel x 3 bytes/pixel x 8 bits/byte x 30 frames/sec ~ 1 Terabit/sec!

CineGrid: A Scalable Approach



What is 4K ?

Most broadly, “4K” describes any new format for motion pictures with 8+ Megapixels per frame.

Strictly speaking, “4K” is one of two new SMPTE DC-28 standard formats for Digital Cinema Theatrical Distribution as recommended by Digital Cinema Initiatives (DCI)

- 4096 x 2160; 24 fps; 4:4:4; 12-bit SMPTE XYZ, Progressive Scan; Square Pixels; JPEG 2000 codec only

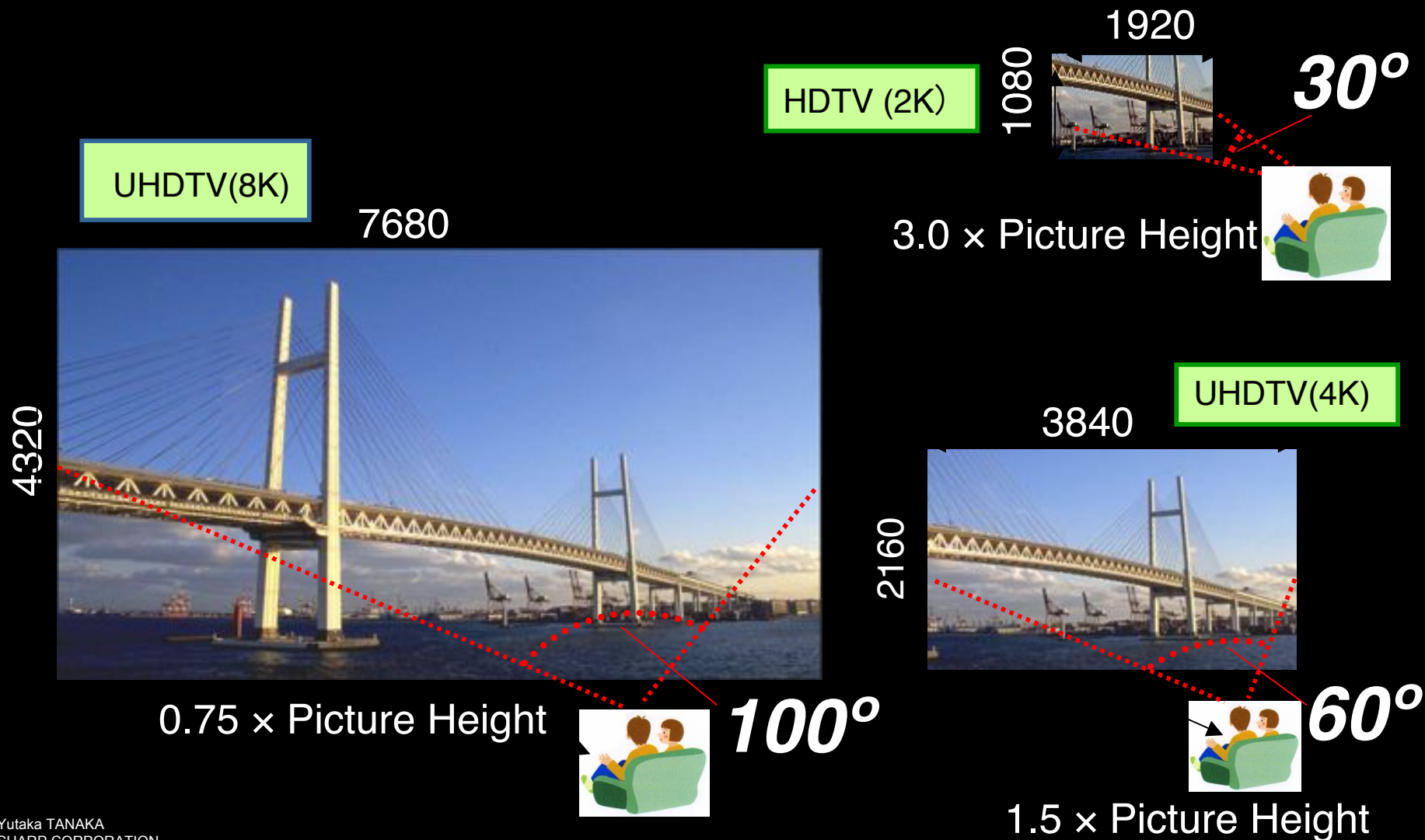
Some “4K” is Quad HDTV (“Super High Definition” or SHD)

- 3840 x 2160; 24/25/30/60 fps; 4:2:2/4:4:4; 10-bit Rec 709; Progressive Scan; Square Pixels; multiple codecs



Why is more resolution is better?

1. More Resolution Allows Closer Viewing of Larger Image
2. Closer Viewing of Larger Image Increases Viewing Angle
3. Increased Viewing Angle Produces Stronger Emotional Response



Saint Issac's cathedral in St.
Petersburg, Russia

Original art is 3 meters tall by 1
meter wide; designed to hang
high up on the wall!

Original photograph shot from
about 3 meters distance.

Camera resolution of
12 Mpixels (4K x 3K)





Original shot from about 1 meters distance



Original shot from about 0.3 meters distance

Moving Big Data Objects Globally

❑ Digital Motion Picture for Audio Post-Production

- 1 TV Episode Dubbing Reference ~ 1 GB
- 1 Theatrical 5.1 Final Mix ~ 8 GB
- 1 Theatrical Feature Dubbing reference ~ 30 GB

❑ Digital Motion Picture Acquisition

- 4K RGB x 24 FPS x 10bit/color: ~ 48MB/Frame uncompressed (*ideal*)
- 6:1 ~ 20:1 shooting ratios => 48TB ~ 160TB digital camera originals

❑ Digital Dailies

- HD compressed MPEG-2 @ 25 ~ 50 Mb/s

❑ Digital Post-production and Visual Effects

- Gigabytes - Terabytes to Select Sites Depending on Project

❑ Digital Motion Picture Distribution

- Film Printing in Regions
 - ❑ Features ~ 8TB
 - ❑ Trailers ~ 200GB
- Digital Cinema Package to Theatres
 - ❑ Features ~ 100 - 300GB per DCP
 - ❑ Trailers ~ 2 - 4GB per DCP
- Web Download to Consumers
 - ❑ Features ~ 1.3GB
 - ❑ TV Shows ~ 600MB

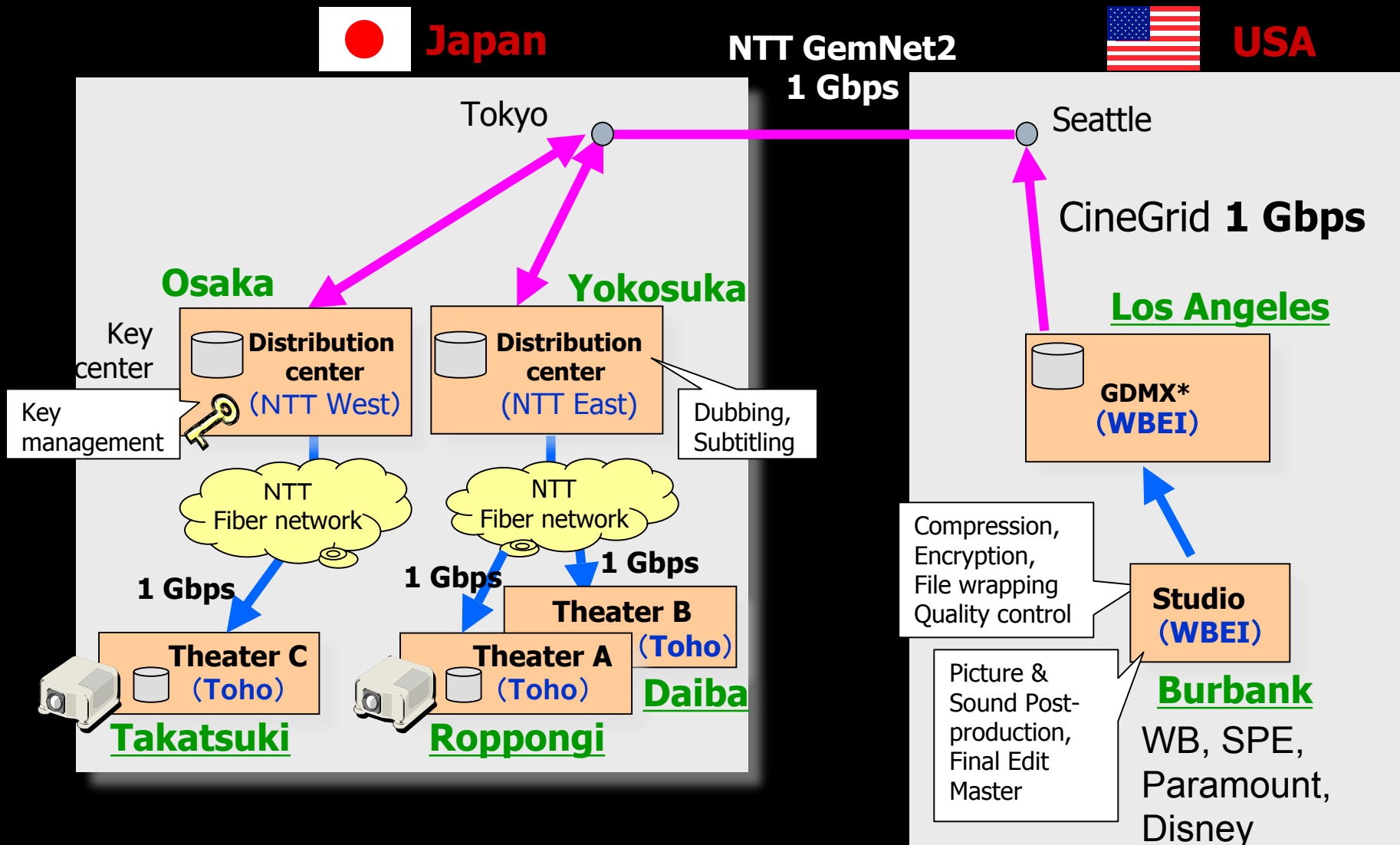
CineGrid projects run over the Global Lambda Integrated Facility (GLIF) backbone



2008 GLIF Visualization by Bob Patterson, NCSA/UIUC

4K Pure Cinema Field Trial 2005-2007

Hollywood to Japan via CineGrid



“Learning by Doing”

Early CineGrid Projects



CineGrid @ iGrid 2005



CineGrid @ AES 2006



CineGrid @ Holland Festival 2007



CineGrid @ GLIF 2007



World's First Trans-Pacific 4K Teleconference (Live!) Keio University (Tokyo) to UCSD/Calit2 (San Diego)

Like High-Def? Here Comes the Next Level
By [JOHN MARKOFF](#)
Published: September 26, 2005

The New York Times
ON THE WEB

Used
1Gbps
Dedicated

NTT
Sony
SGI
Olympus
Mitsubishi
Yamaha
Toppan

Keio University
President Anzai

UCSD
Chancellor Fox

iGrid 2005

CineGrid @ AES 2006

Keio Wagner Society String Ensemble



CineGrid @ Holland Festival 2007



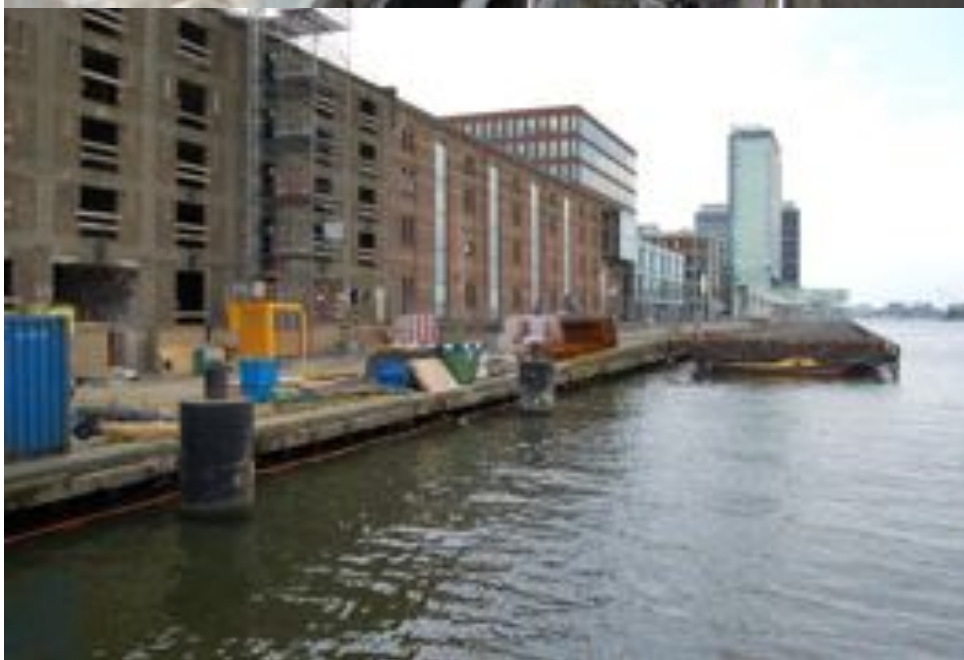
Era la Notte, June 20-21, 2007 (Live!)

CineGrid @ Holland Festival 2007



Muziek Gebouw Aan'tIJ, Amsterdam

Swimming Fiber the Last 500m in Amsterdam

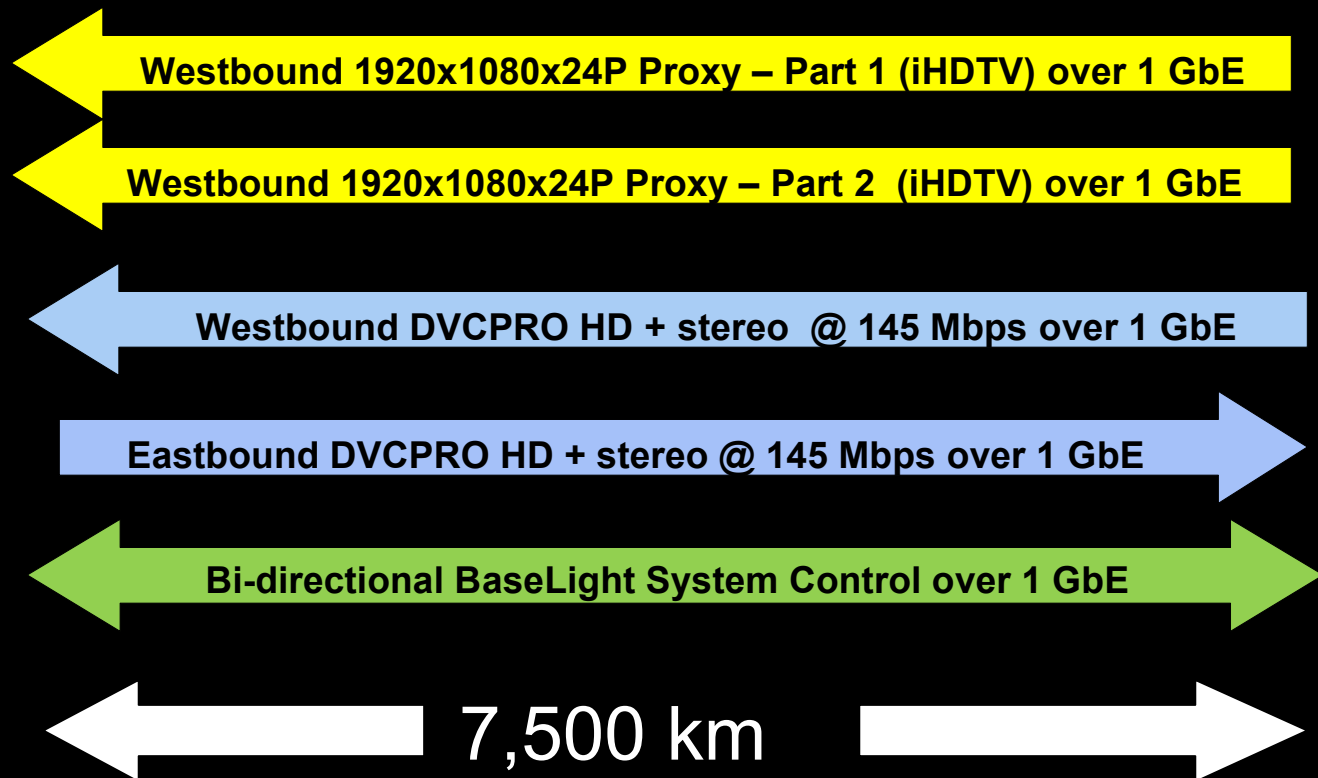


CineGrid in Prague @ GLIF 2007



CineGrid @ GLIF 2007

Multiple
Parallel Signal
Payloads over
10 GigE

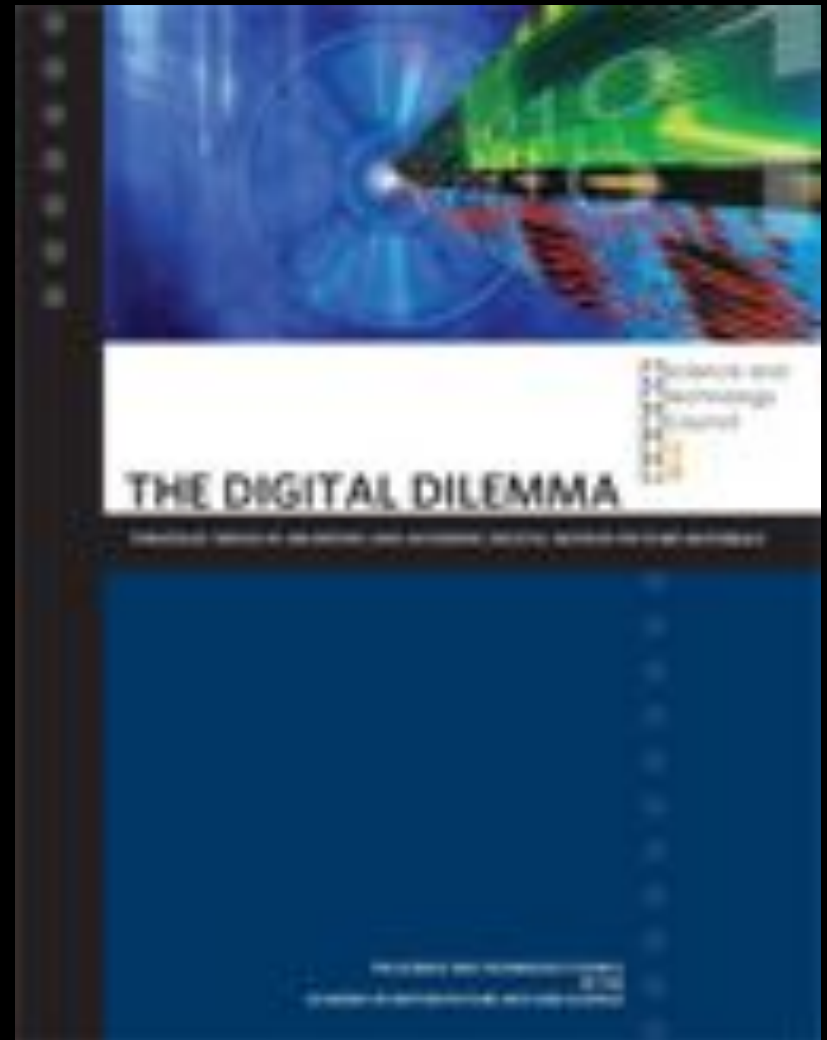


Toronto, Canada
Rogers Communications Centre
Ryerson University

Prague, Czech Republic
CINEPost
Barrandov Studios

CineGrid Exchange

- ❑ TERABYTES PILING UP. To store & distribute its own collection of digital media assets. Members access materials for experiments and demonstrations.
- ❑ THE DIGITAL DILEMMA. Report published by the Science Technology Council of the Academy of Motion Picture Arts and Sciences
- ❑ GLOBAL SCALE TESTBED = high quality media assets + distributed storage + fast networks
- ❑ EXPLORE strategic issues in digital media storage, access, distribution and preservation – for cinema, scientific visualization, television, etc.



CineGrid Exchange 2008

Geographically Distributed Nodes + Fast Networks

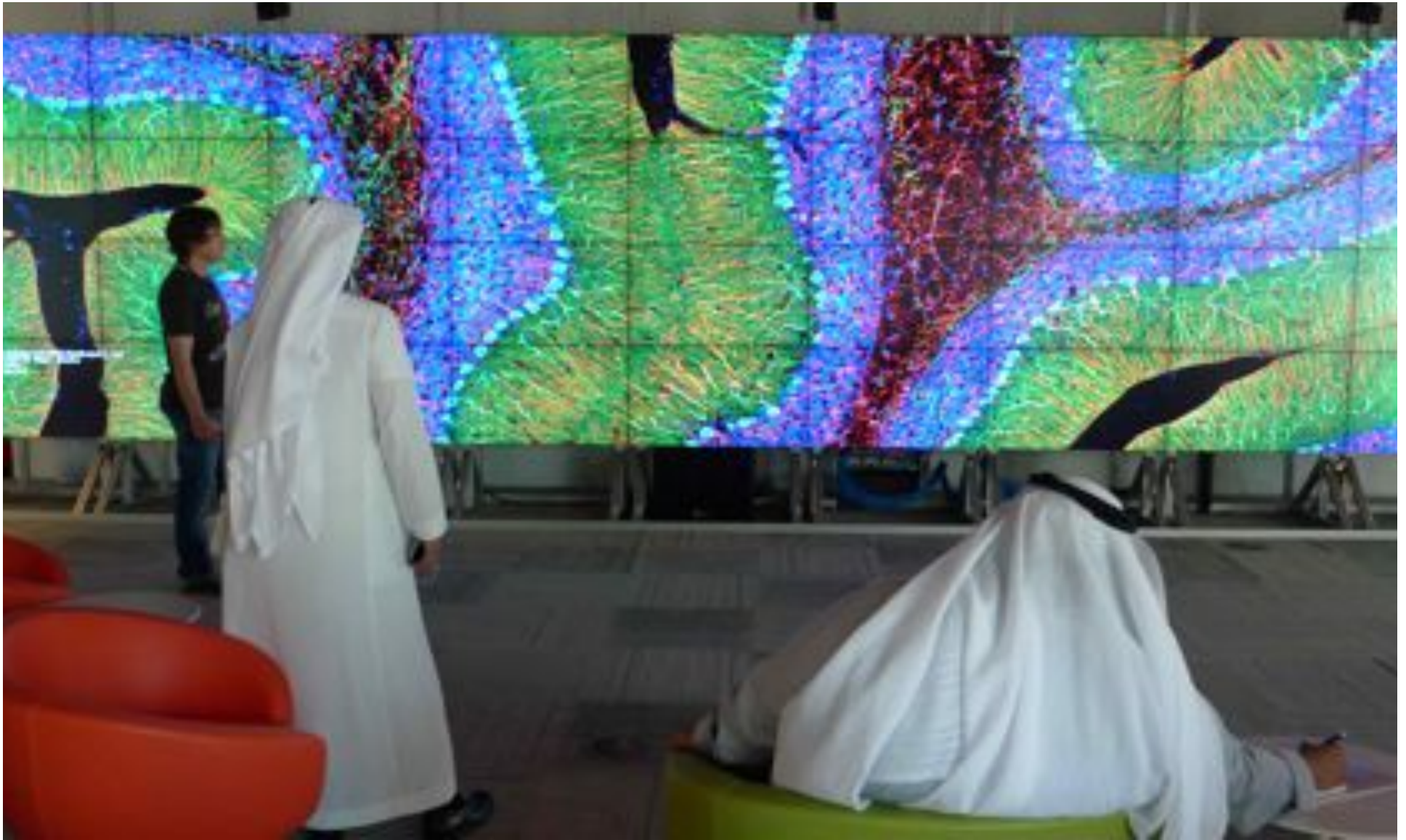


CineGrid Exchange 2009-2010

- Build multi-layer open-source framework for distributed digital media repository
- Implement iRODS middleware using funding from AMPAS
- Working Group: AMPAS, PII, Ryerson, UCSD, UIC, UW, UvA, Keio, NTT, CESNET, Naval Postgraduate School

CX Node Site	Storage Type	CX Allocation
UCSD/Calit2, San Diego, USA	Sun Thumper (x4540)	66 TB
UvA, Amsterdam, Netherlands	Sun Thumper (x4540)	30 TB
UIC/EVL, Chicago, USA	JBOD RAID 0	10 TB
Keio U./DMC, Tokyo, Japan	JBOD RAID 0	8 TB
CESNET, Prague, Czech Republic	Sun Thumper (x4540)	48 TB
Ryerson U, Toronto, Canada	Sun Thumper (x4540)	57 TB
AMPAS, Los Angeles, USA	Sun Thumper (x4540)	24 TB
Total CineGrid Exchange Capacity		243 TB





42 megapixel tiled display at KAUST 2009
narrow-bezel 720p LCD



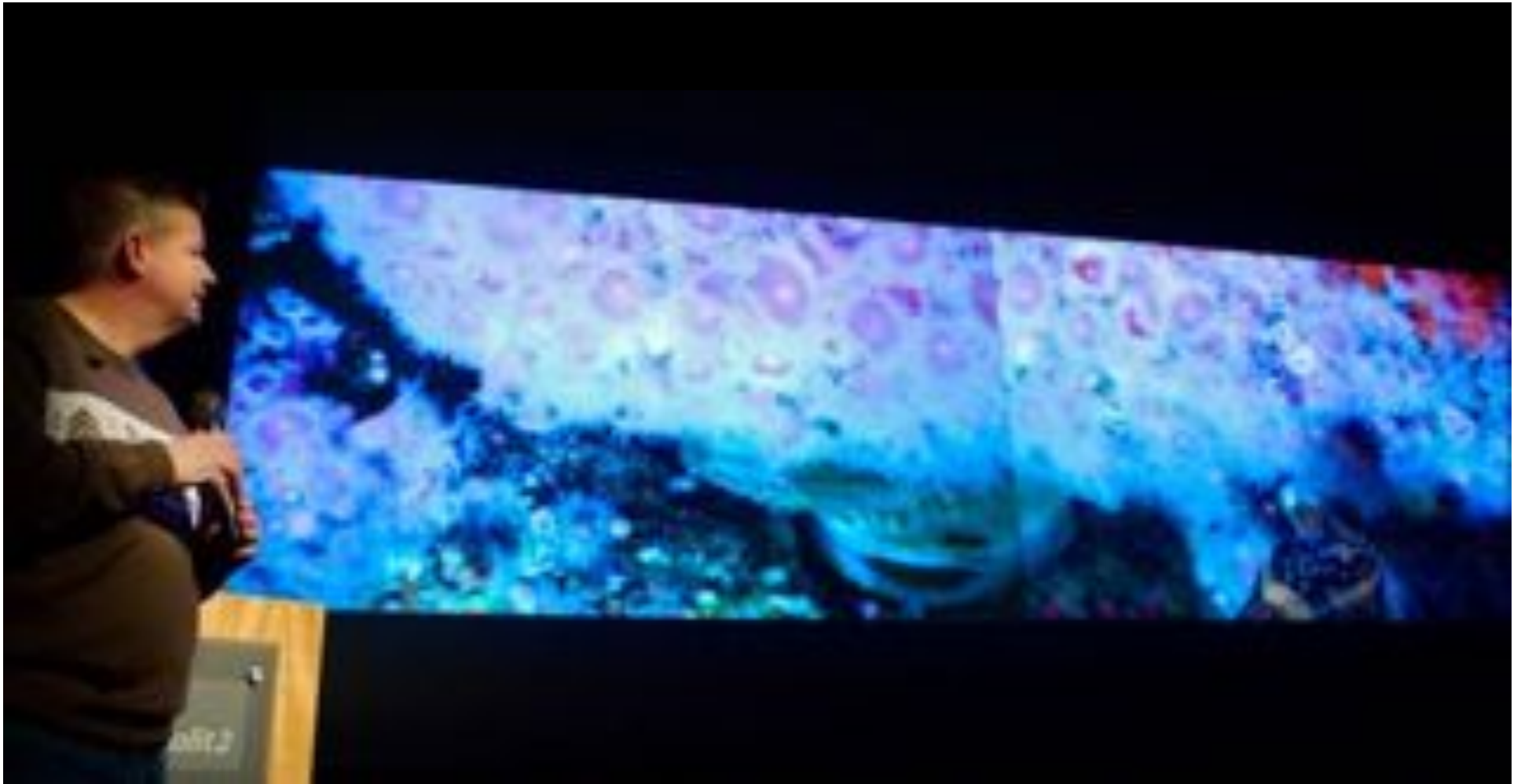
Multi-user distributed collaboration at UIC/EVL
scalable Vizcasting and distributed GUI using SAGE



42 megapixel stereoscopic immersive display
with 3D head-tracking at UCSD/Calit2 2009
micropolarized 1080p LCD



4K/2K multipoint interactive telepresence
live 4K JPEG 2000 streaming over IP in 2008
Keio@Tokyo ◀...▶ EVL@Chicago ◀...▶ Calit2@San Diego



8K x 2K x 60p live remote sensing

dual 4K/60p cameras & dual 4K JPEG 2000 codecs
synchronized 4K JPEG 2000 streaming over IP in 2009

Monterey Bay Aquarium► NPS@Monterey► Calit2@San Diego



4K interactive digital cinema color grading
realtime 4K uncompressed streaming over IP in 2009

CinePOST@Prague ◀.....▶ Calit2@San Diego



Tele-collaboration for audio post-production
synchronized picture/sound editing over IP in 2009
Skywalker Sound@Marin ◀.....▶ Calit2@San Diego



CineGrid International Workshop
December 13-15, 2010 in San Diego



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